PATENT ABSTRACTS OF JAPAN

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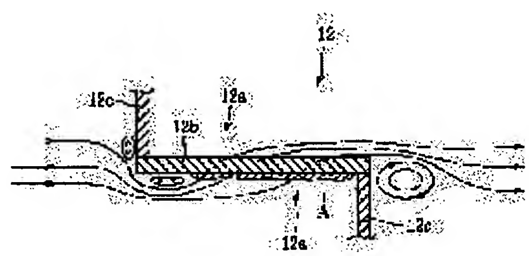
(54) ESTIMATING METHOD OF COLLECTION AMOUNT BY PARTICULATE FILTER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an estimating method of a particulate collecting amount allowing accurate estimation of a particulate collecting amount accumulating on a filter and forcible regeneration control of the filter at an appropriate timing.
SOLUTION: Regarding pressure loss ΔPclean of a DPF itself in a clean state having no effect of combustion of the particulates, an accurate pressure loss characteristic can be measured by a previous test, so that pressure loss ΔPclean rt corresponding to a reference temperature based on a map obtained by the measurement is determined (S12). Regarding pressure loss ΔPw of the particulates, the pressure loss can be considered to be a relatively simple characteristic, so that the pressure loss is converted to a value ΔPw/μex at the reference temperature using viscosity coefficient μex of exhaust gas. A total pressure loss ΔPrt of the DPF at the reference temperature is derived based on the values ΔPclean rt and ΔPw/μex (S14), and a collecting amount is estimated based on the total pressure loss Πrt (S15).



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CLAIMS

[Claim(s)]
[Claim 1] In the presumed approach of the amount of particulate uptake in the particulate filter which is prepared in an internal combustion engine's flueway and carries out uptake of the particulate under exhaust air, while detecting the pressure loss of the above-mentioned filter The amount of emission and filter temperature which pass the above-mentioned filter are detected or presumed. Particulate deposition part pressure loss is computed based on the body part pressure loss of a filter searched for according to the amount of emission and filter temperature which were presumed [which presumed and above-detected], and the pressure loss which carried out [above-mentioned] detection. Based on the body part pressure loss of a base-temperature equivalent filter searched for according to the amount of emission presumed [which presumed and above-detected], and the base-temperature equivalent particulate deposition part pressure loss which converted the above-mentioned particulate deposition part pressure loss into an equivalent for a base temperature, base-temperature corresponding pressure force loss is searched for. The amount presumption approach of uptake of the particulate filter characterized by presuming the amount of particulate uptake based on the amount of emission presumed [which presumed and above-detected] to be the above-mentioned base-temperature corresponding pressure force loss.
[Claim 2] It is the amount presumption approach of uptake of the particulate filter according to claim 1 characterized by performing the conversion to the above-mentioned base-temperature equivalent particulate deposition part pressure loss based on the multiplier according to the above-mentioned filter temperature, and the above-mentioned particulate deposition part pressure loss.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the presumed approach of the amount of particulate uptake in the particulate filter which is prepared in an internal combustion engine's (henceforth an engine) flueway, and carries out uptake of the particulate under exhaust air.
[0002]
[A related background technique] Many particulates else [, such as HC, CO, and NOx,] are contained in the exhaust gas discharged from a diesel power plant, and the particulate filter which carries out uptake of the particulate in exhaust gas is proposed as after-treatment equipment for processing this particulate. Since there is a limitation in the amount of particulate uptake of a filter, presumed processing of the amount of uptake is carried out, and when the presumed amount of uptake reaches a predetermined value, compulsive playback control which carries out the temperature up of the filter and carries out incineration removal of the particulate on a filter is carried out.
[0003] Paying attention to the amount of uptake correlating as presumed processing of the amount of particulate uptake to the pressure loss (filter order differential pressure) in the amount of emission, and a filter, the technique of presuming the amount of uptake is enforced from the amount of emission, and the filter pressure loss according to the map set up beforehand. However, a filter pressure-loss condition is changed and the pressure-loss condition in a filter has the problem that an error will arise in the amount of presumed uptake as a result, when the viscosity of exhaust gas changes with an exhaust-gas temperature with change of engine operational status even if the amount of emission is the same since it is influenced by the viscosity of exhaust gas.
[0004]
[Problem(s) to be Solved by the Invention] It is possible to set up the above-mentioned map for every temperature, and to calculate the amount of uptake from the map corresponding to temperature as the cure. The map at this time is set up by measuring a filter pressure loss, changing the amount of particulate uptake, and the capacity which circulates a filter in each temperature by prior trial. However, it will lapse into the situation which a particulate burns and cannot measure a pressure loss, for example by the pyrosphere 600 degrees C or more if the gas containing oxygen is circulated in a filter. Then, although using inert gas is also considered, another problem of requiring a large-scale test facility in this case arises.
[0005] Moreover, by making into reference temperature the temperature region (for example, room temperature) which does not have fear of the particulate above-mentioned combustion as another cure, a map setup is carried out and computing the amount of uptake based on the map of reference temperature, after converting into the value in reference temperature the filter pressure loss detected by the pyrosphere using the coefficient of viscosity according to temperature is also considered. However, the conversion processing which various factors, for example, the path configuration of a filter, pore content or the amounts of particulate uptake, etc. overlap, generates the pressure loss in a filter, and took all the factors into consideration is impossible. Therefore, gross errors will be contained in the filter pressure loss after converting into reference temperature, and the problem that presumption of the amount of uptake exact as a result cannot be performed will arise.
[0006] Moreover, although the technique in which it detects the amount of uptake of a filter correctly is indicated even if an exhaust-gas temperature changes to JP,9-88554,A by amending the detection value of filter pressure loss with filter temperature and filter heat capacity about amendment by filter temperature, the multiplication of the filter temperature estimate Td is simply carried out to pressure loss (differential pressure) -- **** -- it is difficult to make the effect of temperature to the detection value of the filter pressure loss which it does not pass, but various kinds of flow combines, and is generated reflect in the amount of uptake correctly.

[0007] Then, the place which it is made in order that this invention may solve such a trouble, and is made into the purpose is to offer the presumed approach of the amount of particulate uptake that the particulate amount of uptake deposited on the filter can be presumed correctly, as a result compulsive playback control of a filter can be carried out to suitable timing.

[0008]

[Means for Solving the Problem] As a result of an invention-in-this-application person's advancing further research, total pressure force loss of a filter acquired knowledge that it can divide roughly into the pressure loss by the particulate by which uptake was carried out to the pressure loss (pressure loss by a path configuration, pore content, etc. of a filter) of the filter itself. And about the pressure loss of the filter itself, since it is not influenced of [for particulate deposition], high presumption of precision is easy, and since a particulate accumulates on the filtering area of a filter in the shape of a layer and is regarded as a comparatively simple property about particulate pressure loss on the other hand, it is surmised that it is correctly convertible into the value of predetermined temperature.

[0009] In order to attain the above-mentioned purpose on the radical of the above knowledge, so, in invention of claim 1 In the presumed approach of the amount of particulate uptake in the particulate filter which is prepared in an internal combustion engine's flueway and carries out uptake of the particulate under exhaust air, while detecting the pressure loss of a filter The amount of emission and filter temperature which pass a filter are detected or presumed. Particulate deposition part pressure loss is computed based on the body part pressure loss of a filter searched for according to the amount of emission and filter temperature which were detected or presumed, and the detected pressure loss. Based on the body part pressure loss of a base-temperature equivalent filter searched for according to the amount of emission detected or presumed, and the base-temperature equivalent particulate deposition part pressure loss which converted particulate deposition part pressure loss into an equivalent for a base temperature, base-temperature corresponding pressure force loss is searched for. The amount of particulate uptake was presumed based on the amount of emission detected or presumed to be base-temperature corresponding pressure force loss.

[0010] Namely, since the body part pressure loss of a filter searched for according to the amount of emission and filter temperature is not influenced of [for particulate deposition], high presumption of precision is easy for it, and if this body part pressure loss of a filter and the detected pressure loss are used, it can presume particulate deposition part pressure loss with a sufficient precision. And since the pressure loss for the body of a filter does not influence, particulate loss part pressure loss If the body part pressure loss of a base-temperature equivalent filter which changing with a sufficient precision is easy for the particulate deposition part pressure loss of a base temperature, and can be found according to the amount of emission, and this base-temperature equivalent particulate deposition part pressure loss are used The value which changed into an equivalent for reference temperature the pressure loss detected [which detected and reference-temperature-corresponding-pressure-force-lost] can be calculated with a sufficient precision. And based on this base-temperature corresponding pressure force loss and the amount of emission, presumption becomes possible very correctly about the amount of particulate uptake, and the amount of uptake can be correctly presumed also under an elevated temperature.

[0011] It is desirable to perform presumption of the above-mentioned amount of particulate uptake as a desirable mode based on the map set up from the test result in a predetermined reference temperature. For example, if the room temperature which does not have fear of particulate combustion as a base temperature is set up, in the case of a trial, without burning a particulate,-izing of the property of the amount of uptake over pressure loss (base-temperature corresponding pressure force loss) and the amount of emission can be carried out [map] easily and appropriately, and the amount of uptake can be presumed in a high precision based on the map.

[0012] Moreover, it is desirable to search for the above-mentioned body part pressure loss of a filter as another desirable mode based on the map set up from the test result using the filter in the clean condition that uptake of the particulate is not carried out. It can carry out [map]-izing of the property of the pressure loss of the filter itself appropriately, and can search for the body part pressure loss of a filter in a high precision as a result while it can also acquire the test data under an elevated temperature, since the filter of a clean condition is not influenced at all by particulate combustion.

[0013] Moreover, in invention of claim 2, it was made to perform the conversion to base-temperature equivalent particulate deposition part pressure loss based on the multiplier and particulate deposition part pressure loss according to filter temperature. Therefore, it becomes realizable easily by using the multiplier according to filter temperature about the conversion processing correlated with a viscous change of the exhaust gas accompanying a temperature change.

[0014] As a desirable mode, it is desirable to apply the coefficient of viscosity of exhaust gas as the above-mentioned multiplier, and since the coefficient of viscosity of exhaust gas is generally used widely and has high dependability, it can raise the precision of conversion processing more to the top where a setup as a multiplier is easy.

[0015]

[Embodiment of the Invention] Hereafter, 1 operation gestalt of the amount presumption approach of uptake of the particulate filter which materialized this invention is explained. Drawing 1 is the whole block diagram showing the exhaust air processor which enforces the amount presumption approach of uptake of the particulate filter of this operation gestalt. The exhaust emission control device concerned is applied to the common rail type diesel power plant 1, and distribution supply of the high-pressure fuel accumulated to the common rail which is not illustrated is carried out at the fuel injection nozzle 2 of each gas column, and it is injected by the combustion chamber of an engine 1 according to valve opening of a fuel injection nozzle 2.

[0016] Compressor 5a of an intake air flow sensor 4 and a turbocharger 5, the intercooler 6, and the inhalation-of-air throttle valve 7 are formed in the inhalation-of-air path 3 of an engine 1 from the upstream. Moreover, turbine 5b of the turbocharger 5 combined on the same axle to said compressor 5a, an oxidation catalyst 9, upstream temperature sensor 10a, upstream pressure sensor 11a, DPF (diesel particulate filter)12 as a filter, downstream pressure sensor 11b, downstream temperature sensor 10b, and the exhaust air throttle valve 13 are formed in the flueway 8 from the upstream.

[0017] DPF12 consists of ceramic support of a honeycomb mold, and as shown in the partial expanded sectional view of drawing 2 , as an arrow head shows, it circulates exhaust gas through filtering area 12b of the porosity which forms path 12a all over drawing by closing opening of the upstream of much exhaust gas path 12a, and the downstream by plug 12c by turns. And the after-treatment equipment 14 called the so-called continuation playback type DPF is constituted by an oxidation catalyst 9 and DPF12.

[0018] Moreover, from the inhalation-of-air throttle valve 7 of said inhalation-of-air path 3, an upper location is connected by turbine 5b of a down-stream location and said flueway 8 by the EGR path 15, and exhaust gas flows back to the inhalation-of-air path 3 side as EGR gas through this EGR path 15. The EGR valve 16 and EGR cooler 17 are formed in the EGR path 15, and the amount of reflux of said EGR gas is adjusted according to the opening of the EGR valve 16.

[0019] ECU (electronic control unit)21 equipped with the storage (ROM, RAM, etc.) with which storage of the I/O device and control program which are not illustrated, a control map, etc. is presented on the other hand, the central processing unit (CPU), the timer counter, etc. is installed. Various sensors, such as the accelerator sensor 22 which detects accelerator control input thetaacc, the rotational-speed sensor 23 which detects an engine speed Ne, said intake air flow sensor 4, the temperature sensors 10a and 10b of the upstream and the downstream, and pressure sensors 11a and 11b, are connected to the input side of ECU21, and the various devices of said fuel injection nozzle 2, the inhalation-of-air throttle valve 7, the exhaust air throttle valve 13, and EGR valve 16 grade are connected to the output side.

[0020] ECU21 controls the opening of the EGR valve 16, controls the amount of EGR reflux, and, thereby, makes an engine 1 operate in a proper field while it controls the fuel oil consumption and fuel injection timing by the fuel injection nozzle 2 based on the detection information from sensors. On the other hand, as shown in drawing 2 , in case the particulate A contained in exhaust gas passes DPF12 of after-treatment equipment 14, it is caught by filtering area 12b, and is deposited in the shape of a layer on filtering area 12b. Incineration removal of the particulate A on filtering area 12b is carried out continuously, and, thereby, discharge of Particulate A into atmospheric air is prevented by the oxidizing agent (NO2) with which DPF temperature was generated by the upstream oxidation catalyst 9 in the operational status more than predetermined.

[0021] Moreover, the operational status from which such a continuation retroaction is not acquired is continued, and if the amount of particulate uptake in DPF12 increases gradually and reaches a predetermined value, ECU21 will carry out compulsive playback control which carries out incineration removal of the particulate A compulsorily. With this operation gestalt, postinjection whose expansion line is set like an exhaust air line, and injects an additional fuel after the usual fuel injection (main injection) as compulsive playback control is carried out. An expansion line is carried out by the side and this postinjection makes an additional fuel react with the oxygen under exhaust air as unburnt fuels (HC, CO, etc.) first. Activation of the oxidation catalyst 9 by the exhaust air temperature up is attained, after that, an exhaust air line switches fuel injection timing to a side, and combustion removal of Particulate A on DPF12 is aimed at with the heat of reaction when oxidizing unburnt fuels (HC, CO, etc.) on an oxidation catalyst 9.

[0022] While an engine 1 is in the operational status (for example, engine warming-up completion, an engine load, rotational speed more than predetermined, etc.) which can perform compulsive playback control as a start condition of the above-mentioned forcible playback control, it is set up that the amount of particulate uptake has reached the predetermined value. For this reason, ECU21 is performing the amount presumption routine of particulate uptake shown in drawing 3 by the predetermined control interval that the amount of particulate uptake should be presumed, and explains that detail hereafter.

[0023] First, ECU21 is step S2, computes pressure-loss deltaP (=P1-P2) in DPF12 from the detection values P1 and P2 of the upstream and the downstream pressure sensors 11a and 11b, and computes the amount V of emission which circulates DPF12 by continuing step S4. Since exhaust gas is generated when an injection fuel burns in inhalation air, the amount V of emission is computed based on the engine speed Ne detected by fuel oil consumption, the inhalation air content A detected with the intake air flow sensor 4, and the rotational-speed sensor 23.

[0024] Then, it considers that the detection value T2 of downstream temperature sensor 10b is the temperature of DPF12 at step S6, and pressure-loss deltaPclean of DPF itself when having not carried out uptake of the particulate A (henceforth a clean condition) is computed from this DPF temperature and the amount V of emission. Here, the total pressure loss (namely, deltaP based on the above-mentioned sensor appearance) by DPF12 can be divided roughly into the pressure loss (deltaPw mentioned later) by the particulate A by which uptake was carried out to pressure-loss deltaPclean (pressure loss by a path configuration, pore content, etc. of the filter itself) of DPF itself. And at DPF12 of a clean condition, from the combustion phenomenon of Particulate A not arising, the temperature up of DPF12 is actually carried out, it is possible to ask for the relation between DPF temperature, the amount V of emission, and pressure-loss deltaPclean in a high precision by trial, and pressure-loss deltaPclean of DPF corresponding to current DPF temperature and the amount V of emission itself is calculated at step S6 using the map (with no illustration) set up by doing in this way.

[0025] At continuing step S8, pressure-loss deltaPw by the particulate A in current DPF temperature is computed according to a bottom type (1).

delta Pw=delta P-delta Pclean ...... (1) -- further, according to the map (with no illustration) beforehand set up at step S10, from current DPF temperature, coefficient-of-viscosity mu ex of exhaust gas is computed, and pressure-loss deltaPcleanrt when making the current amount V of emission to DPF temperature into reference temperature (set as the room temperature with this operation gestalt) is calculated at continuing step S12 based on the map applied at the above-mentioned step S6.

[0026] Then, total pressure loss deltaPrt of DPF12 in reference temperature is computed at step S14 according to a bottom type (2).

delta Prt=delta Pw/mu ex+delta Pclean rt ...... (2) Here, delta Pw/mu ex expresses the pressure loss by the particulate A in a base temperature. That is, although Particulate A becomes the factor which burns in a pyrosphere and bars measurement of a pressure-loss property in the case of a trial, as shown in drawing 2 , since Particulate A is deposited on filtering area 12b of DPF12 in the shape of a layer, it can regard the pressure-loss deltaPw as a comparatively simple property, and it can be converted into the value of reference temperature in a high precision only by doing a division by coefficient-of-viscosity muex.

[0027] Then, according to the map of drawing 4 , the amount of particulate uptake is calculated from total pressure loss deltaPrt of DPF12 in a base temperature, and the amount V of emission at continuing step S16, and a routine is ended. The map property of drawing 3 is set up by measuring pressure-loss deltaPrt in DPF12 by prior trial, changing the amount of particulate uptake, and the amount V of exhaust gas circulation. This trial is measured easily [the property of pressure-loss deltaPrt and the amount of particulate uptake to the amount V of exhaust gas circulation], and appropriately, without burning Particulate A, since it carries out at a room temperature (base temperature). And the amount of particulate uptake which carried out in this way and was presumed is used for the initiation judging of compulsive playback control as mentioned above.

[0028] As mentioned above by the amount presumption approach of uptake of the particulate filter of this operation gestalt About pressure-loss deltaPclean [the body part pressure loss of a filter] of DPF of a clean condition itself From not being influenced by combustion of Particulate A, pressure-loss deltaPclean rt [the body part pressure loss of a reference-temperature equivalent filter] of DPF itself [of reference temperature] is calculated based on the map of the pressure-loss property acquired from the prior trial (step S12). On the other hand About pressure-loss deltaPw [particulate deposition part pressure loss] by Particulate A Since it can regard as a comparatively simple property, do a division by coefficient-of-viscosity muex of exhaust gas, and it converts into value delta Pw/mu ex of a base temperature [base-temperature equivalent particulate deposition part pressure loss] (step S14). The amount of particulate uptake is presumed based on these value deltaPclean rt and total pressure loss deltaPrt [base-temperature corresponding pressure force loss] of DPF12 in the base temperature for which it asked from delta Pw/mu ex (step S16).

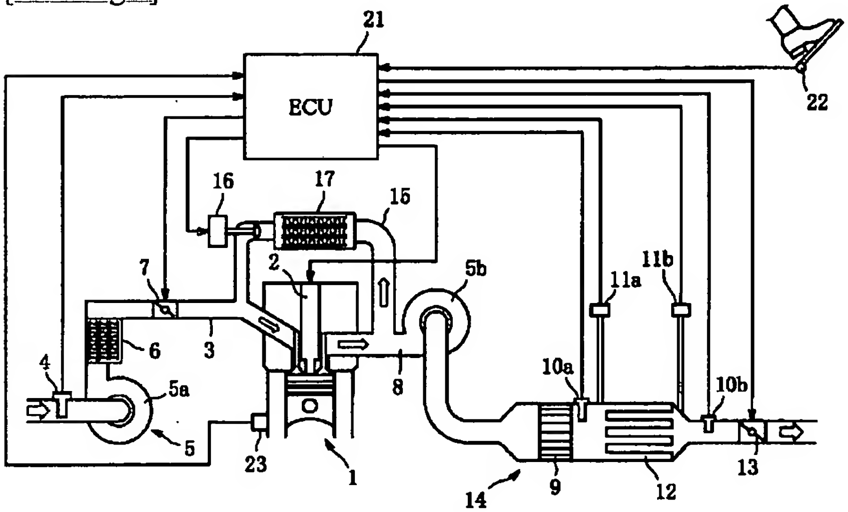
[0029] Therefore, while pressure-loss deltaPclean rt of DPF of reference temperature itself is calculated in a high precision based on a map, without being influenced by combustion of Particulate A Pressure-loss delta Pw/mu ex by the particulate A of a base temperature is converted in a high precision using coefficient-of-viscosity muex. As a result Based on these value deltaPclean rt and total pressure loss deltaPrt of DPF12 in the base temperature for which it asked from delta Pw/mu ex, the amount of particulate uptake can be presumed very correctly, as a result compulsive playback

control of DPF12 can be carried out to suitable timing.
[0030] Moreover, what is necessary is to set the amount of particulate uptake as 0 (clean condition), to set the pressure-loss property (step S for it to be used by 6 and 12) and DPF temperature when changing DPF temperature and the amount V of emission as reference temperature, and just to measure the pressure-loss property (for it to be used at step S16) when changing the amount of uptake, and the amount V of emission in a prior trial. that is, since a test dose is markedly alike and decreases about all DPF temperature like the conventional technique of the preceding paragraph as compared with the case where the pressure-loss property over the amount of emission and the amount of uptake is measured in matrix, while being able to reduce trial cost, it can respond to specification modification of DPF12 etc. easily.
[0031] Furthermore, since only pressure-loss deltaPw of Particulate A of a comparatively simple property is converted into the reference-temperature equivalent value, as concrete processing, a division is only done by coefficient-of-viscosity muex. That is, as compared with the case where conversion processing in consideration of all the factors in connection with a filter pressure loss is carried out like the conventional technique mentioned as another cure, very easy data processing can realize and there is also an advantage that the cost rise of ECU21 can be controlled as a result.
[0032] Although explanation of an operation gestalt is finished above, the mode of this invention is not limited to this operation gestalt. For example, although shape was taken with the above-mentioned operation gestalt to the amount presumption approach of uptake for DPF12 with which the common rail type diesel power plant 1 was equipped and which formed the oxidation catalyst 9 in the upstream The format of an engine 1 and the structure of DPF12 may be materialized not only to this but to the amount presumption approach of uptake for DPF12 which applied to the usual diesel power plant, or was united with the oxidation catalyst 9, or independent DPF12 which omitted the oxidation catalyst 9.
[0033] Moreover, although filter temperature (detection value T2) was detected and the amount V of emission was presumed with the above-mentioned operation gestalt from fuel oil consumption, the inhalation air content A, and the engine speed Ne What was obtained from what kind of technique is sufficient as each parameter used for the amount presumption approach of uptake of this operation gestalt. For example, based on the change condition of the sensor appearance value T2, the current filter temperature after taking the response delay of a sensor into consideration may be presumed, or a direct sensor may detect the amount V of emission.
[0034]
[Effect of the Invention] As explained above, according to the amount presumption approach of uptake of the particulate filter invention of claim 1, the particulate amount of uptake deposited on the filter can be correctly presumed also under an elevated temperature, as a result compulsive playback control of a filter can be carried out to suitable timing.
[0035] Moreover, according to the amount presumption approach of uptake of the particulate filter invention of claim 2, since the conversion to base-temperature equivalent particulate deposition part pressure loss are performed using the multiplier according to filter temperature in addition to invention of claim 1, the conversion processing correlated with a viscous change of the exhaust gas accompanying a temperature change is easily realizable.

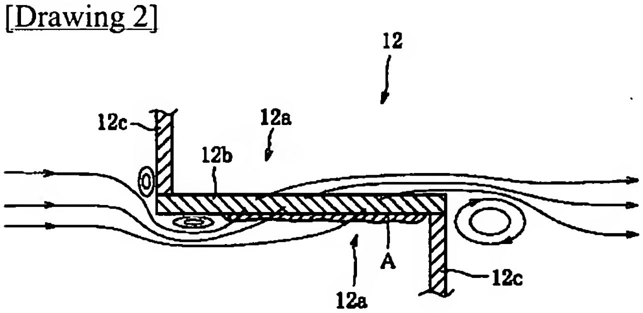
[Translation done.]

DRAWINGS

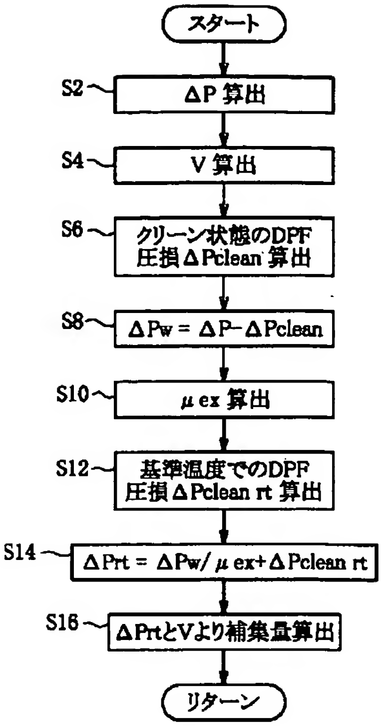
[Drawing 1]



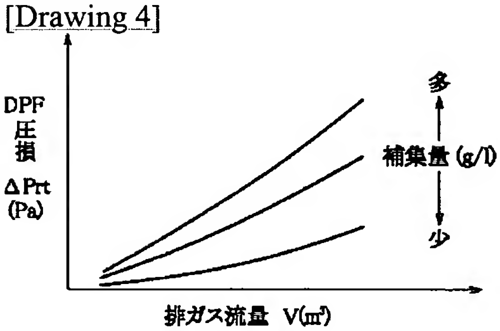
[Drawing 2]



[Drawing 3]



[Drawing 4]



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